

Wintering Habitat Evaluation of Red Deer (*Cervus elaphus*) in Forest Area of Northeastern China¹

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Abstract Six ultimate factors (forage abundance, horizontal sheltering class, distance from human disturbance, snow depth, tree coverage, and edge effect) of Red deer (*Cervus elaphus*) were investigated in eastern Heilongjiang Province during winter from 1988 to 1991. On the basis of analysis of field data, we evaluated winter habitat conditions of Red deer. The results showed as follows: the wintering habitat quality of Red deer in poplar-birch stands was excellent in the Wanda Mountains, and was moderate in shrub-woods and Korean pine seed stands. According to habitat index (HI) values, the habitat quality in poplar-birch stands (HI=0.8185) was superior to that in shrub-woods (HI=0.4825) and in Korean pine seed stands (HI=0.4385). The wintering habitat quality of Red deer in the Wanda Mountains was superior to that of Dailing Forestry Region. According to the current situations of forestry areas in northeastern China, strengthening habitat management was important for the conservation and management of Red deer population in the next decades.

Key words: Red deer, *Cervus elaphus*, Habitat evaluation, Habitat suitability index.

Introduction

The professionals work of wildlife management is a target for population management, but more and more professionals workers are interested in the management of the wildlife habitat (Belley, 1984). It is one of essential works for us to appraise habitat with the scientific management on the Red deer population. So it is useful to conservation, development and utilization of the Red deer in an animal's perspective. Since the 1970's many scientists have been studying the habitat evaluation for deer. Several models and methods such as the linear diagram, the matrix model and the habitat suitability procedure (HEP), were presented or modified subsequently (Schamberger and Farmer, 1978; Boer, 1978; Urich and Graham, 1984; O'neil et al., 1988; Thomasma, 1991), but few had actually been tested. Even if the model was tested, varying results were obtained sometimes leading to model invalidation or modification. The objective of our study was to evaluate the wintering habitat of Red deer in northeastern China by counting the number of tracks and bedding marks in the snow.

Study Areas

Dailing Experimental Forestry Bureau (46°15'-47°21'N, 128°27'-129°8'E) lies at the southern the Xiaoxing'an Mountains. Dongfanghong Forestry Bureau (46°10'-47°15'N; 132°27'-134°5'E) and Yingchun Forestry Bureau (45°50'-46°39'N; 132°22'-133°26'E) are located on the Wanda Mountains, both of which are adjacent to each other and encompasses the whole mountains. The climate is temperate continental and the areas receive the wet monsoons in summer. Mean annual temperature is 1.9°C. Average annual precipitation is about 600-700 mm. Frost-free period lasts 115-120 days. Snowfall period lasts about 5 months. Forest communities include Korean pine-broad leaved stands, Spruce-fir stands, Poplar-birch secondary stands and Shrub-woods etc.

Methods

Habitat characteristics consist of a lot of natural, ecological and social factors. It is difficult to set up a habitat site. Six ultimate factors, which exerted notable influence on habitat selection and used by Red deer

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in winter were surveyed as evaluation factors in this study. Those were as follows: a). forage abundance, b). horizontal sheltering class, c). distance from human disturbance, d). snow depth, e). tree coverage, f). edge effect.

We established 2 or 3-sample site in each study region. In the sample plot along a perpendicular direction to the contour line, a 1000 m line transect was set out randomly. The interval distance of line transects was 1000 m or longer. 10 m×10 m quadrats were placed 100 m apart along the line transect, where 52 m×2 m small quadrats were set in one center and at four inner angles of 10 m×10 m quadrats, respectively. Six habitat factors were analyzed in the sample plot. The observation and measuring methods are as follows:

1. Forage abundance: the number of both stems and twigs available for food of Red deer were counted in each 2 m×2 m quadrat, then converted to dry weights.

2. Horizontal sheltering class: at a distance of 30m, two measuring rods were set on the diagonal line of the 10 m×10 m quadrat. Two observers read the figured, which were unobscured to vision each other (scale ranging from 0.0 to 1.0).

3. Distance from human disturbance: distance from the line transects to villages, farms, sheds, roads, or logging sites, etc. was measured.

4. Snow depth: snow depth was measured with a ruler in each 2 m×2 m quadrat.

5. Tree coverage: diameter at breast height (DBH) of tree (≥4 m) was measured with a calipers in each 10 m×10 m quadrat. The T value was calculated by,

$$T = \sum_{i=1}^n T_i / n$$

where, T =tree coverage value, $T_i = \frac{\pi}{4} \times (\text{DBH})^2$

6. Edge effect: the borders of habitats according to forest and stock map, logging, plantation and improvement, silviculture were determined. The E value was calculated by;

$$E = L/A$$

where, E = edge effect value, L = length of border, A = area of sample plot.

Results and Discussion

Comparison of wintering habitat quality of Red deer in different forest types

From November 1989 to November 1991, in the Wanda Mountains, the Korean pine seed stands, popular-birch secondary stands after logging 15-30 years and shrub-woods after clear-cutting 3-7 years were chosen for our study. In two sample plots, four line transects and 40 quadrats in each forest type were provided, observed and counted twice during each winter (Table 1).

Table 1. Field data of the wintering habitat factors of Red deer in three forest types in the Wanda Mountains of Heilongjiang Province during 1989-1991

Forest types	Plot area (hm ²)	No. of track chain (100 hm ²)	No. of bed- ding marks (100 hm ²)	Forage abundance (g/100 m ²)	Distance from human distur- bance (km)	Snow depth (cm)	Horizontal sheltering class	Tree coverage (m ² /100 m ²)	Edge effect (km/ km ²)
Korean pine seed stand	370	2.20	0.54	115	3.70	25	0.30	2.15	1.50
	290	1.72	0.35	55.0	4.50	20	0.20	1.55	1.20
Popular-birch secondary stand	345	9.79	261	267	3.20	30	0.70	0.90	2.65
	366	5.19	2.29	241	4.00	20	0.50	0.60	2.25
Shrub-wood	289	4.50	1.73	372	1.50	35	0.10	0.10	1.92
	310	2.90	1.29	256	1.70	45	0.20	1.10	1.45

In popular-birch secondary stand, forage abundance, edge effect, tree coverage and horizontal sheltering class were good; distance from human disturbance was quite long; snow depth was not too deep. So the wintering habitat quality of Red deer in this stand was rather superior to other two stands. There were higher densities of tracks and bedding marks of Red deer in it. Calculating by fuzzy comprehensive evaluation formulae, the habitat index (HI) was 0.8185. The comprehensive evaluation result

showed that the wintering habitat quality of Red deer was excellent.

Among the three forest types, the forest age of the Korean pine seed stand, was the oldest and trees were the largest and highest. The stand lay at out-of-the-way place. Shrub layer was few and scattered. So stems and twigs available for food of Red deer in winter were sparse and horizontal sheltering were poor. The wintering habitat quality of Red deer was moderate (HI = 0.4385). There were a few tracks and

bedding marks of Red deer in it.

In the shrub-woods, some Red deers had activities for feeding and bedding in winter because of abundant shrubs and a vast amount of stems and twigs. The wintering habitat quality of Red deer was slightly superior to that in Korean pine seed stand (HI=0.4825).

Comparison of wintering habitat quality of Red deer in different regions

Three plots were sampled at Dailing Forestry Region and the Wanda Mountains respectively from December 1988 to March 1990. We set up 9 line transects, 90 quadrates in each region and observed and counted twice during each winter (Table 2).

In the area of Wanda Mountains human population were sparse and residential sites were scattered. The forest resource exploitation was later and distraction was not serious. The habitat availability resource

(forage, shelter, movement etc) was rather well. Deer population density was higher than that in Dailing Forestry Region. The wintering habitat quality of Red deer in the Wanda Mountains (HI=0.7291) was superior to that in Dailing Forestry Region (0.5795).

Today, as the modern logging machinery have practiced with a large scale in the eastern provincial forestry areas, the frequency of human disturbance activities is raising, and the human disturbance areas are expanding. This situation brings about reducing suitable habitat of deer year by year and influencing on the habitat selection used by deer significantly. On the other hand, the average habitat utilization ratio of deer that will decrease in the whole area. Therefore, strengthening habitat management is important considerations for the conservation and management of the Red deer population in northeastern China in the next decades.

Table 2. Field data of the wintering habitat factors of Red deer in Dailing forestry region and the Wanda Mountains of Heilongjiang Province during 1988-1990

Region	Plot area (hm ²)	No. of track chain (100 hm ²)	No. of bedding marks (100 hm ²)	Forage abun- dance (g/100 m ²)	Distance from human disturbance (km)	Snow depth (cm)	Horizontal sheltering class	Tree cover- age (m ² /100 m)	Edge effect (km/km ²)
Dailing	237	4.64	1.27	282	1.48	30	0.10	0.22	1.29
	315	3.81	1.91	198	2.10	26	0.50	0.59	0.98
	332	2.71	1.51	129	1.50	21	0.30	1.24	1.59
Wanda Mountain	343	5.25	2.04	258	2.57	26	0.20	0.25	0.76
	296	6.76	3.38	304	2.58	22	0.50	0.92	1.59
	264	6.06	3.79	275	2.68	21	0.50	2.01	2.71

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